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$\delta' x$=the density of the fluid at depth x, and for equilibrium the mass of sphere immersed equals the mass of fluid displaced.

Then, r being the radius of the sphere,

$$\delta.\tfrac{4}{3}\pi r^3=\int\int \pi y^2 dx.\delta x=\int_0^{2r}\pi\delta' x(2rx-x^2)dx=\delta'\tfrac{4}{3}\pi r^4. \quad \therefore r=\delta/\delta'.$$

Also solved by *J. SCHEFFER* and *G. B. M. ZERR*.

60. Proposed by J. SCHEFFER, A. M., Hagerstown, Md.

What must be the ratio of the two legs of a uniform and heavy right triangle suspended from the center of the inscribed circle, if this triangle will rest with the shorter leg in a horizontal position ?

I. Solution by WILLIAM HOOVER, A. M., Ph. D., Professor of Mathematics and Astronomy, Ohio University, Athens, Ohio.

If a and b be the longer and shorter side about the right angles, and r the radius of the inscribed circle, we should have

$$\tfrac{1}{2}r[a+b+\surd(a^2+b^2)]=\tfrac{1}{2}ab\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots(1),$$

$$\text{or } r=\tfrac{1}{2}a+\tfrac{1}{2}b-\tfrac{1}{2}\surd(a^2+b^2)\ \ldots\ldots\ldots\ldots\ldots\ldots(2).$$

The triangle is kept in equilibrium by the action of the weights of the sides vertically downwards and the reaction of the point of support.

Taking moments about this fallen point,

$$ra=(\tfrac{1}{2}b-r)\surd(a^2+b^2)+b(\tfrac{1}{2}b-r)\ \ldots\ldots\ldots\ldots\ldots\ldots(3),$$

the sides being taken proportional to their weights.

r from (2) put into (3) gives, by reduction,

$$3a=4b \text{ or } a=\tfrac{4}{3}b\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4).$$

II. Solution by HENRY HEATON, M. Sc., Atlantic, Iowa, and W.W. LANDIS, A. M., Professor of Mathematics, Dickinson College. Carlisle, Pa.

If a and b represent the legs of the triangle the distance of the center of gravity from the leg a is $\tfrac{1}{3}b$. The radius of the inscribed circle is

$$r=\tfrac{1}{2}[a+b-\surd(a^2+b^2)].$$

To secure equilibrium in the desired position r must equal $\tfrac{1}{3}b$, or

$$\tfrac{1}{3}b=\tfrac{1}{2}[a+b-\surd(a^2+b^2)].$$

Whence $b=\tfrac{3}{4}a$, or $b/a=\tfrac{3}{4}$.

In this triangle the centee of gravity is directly above the center of the inscribed circle. Hence the equilibrium is unstable.

III. Solution by G. B. M. ZERR, A. M., Ph. D., President and Professor of Mathematics in Russell College, Lebanon, Va., and J. SCHEFFER, A. M., Hagerstown, Md.

In order that AB may be horizontal the point of suspension O and the center of gravity G must be in the same straight line perpendicular to AB.

Let $AB=x$, $BC=mx$, $AC=x\surd(1+m^2)$. Then $HB=r$=radius of in-circle.

$$2(x-r)+2(mx-r)+2r=x+mx+x\sqrt{(1+m^2)}.$$

$\therefore\ r=\frac{1}{2}x[1+m-\sqrt{(1+m^2)}]$.

$GH=\frac{1}{3}BC=\frac{1}{3}mx,\ KH=\frac{1}{2}AB-HB=\frac{1}{2}x-r$.

$\therefore\ KH=\frac{1}{2}x[\sqrt{(1+m^2)}-m)],\ GK=\frac{1}{3}CK=\frac{1}{3}x\sqrt{(\frac{1}{4}+m^2)}$.

$\therefore\ KG^2=GH^2+KH^2$, or $\frac{1}{9}x^2(\frac{1}{4}+m^2)=\frac{1}{9}m^2x^2+\frac{1}{4}x^2[\sqrt{(1+m^2)}-m]^2$.

$\therefore\ \frac{1}{4}[\sqrt{(1+m^2)}-m]^2=\frac{1}{36}$, or $\sqrt{(1+m^2)}-m=\frac{1}{3}$. $\therefore\ m=\frac{4}{3}$.

$\therefore\ AB:BC=3:4$, and $HB:AB:BC:AC=1:3:4:5$.

Also solved by *J. C. NAGLE.*

DIOPHANTINE ANALYSIS.

60. **Proposed by G. B. M. ZERR, A. M., Ph. D., President and Professor of Mathematics, The Russell College, Lebanon, Va.**

It is required to find six positive numbers, such that if each be diminished by five-half times the fifth power of their sum the six remainders will be rational fifth powers.

Solution by the PROPOSER.

Let u, v, w, x, y, z, be the six numbers required, and let $u+v+w+x+y+z=s$.

Then $u-\frac{5}{2}s^5=h^5s^5/q^5$, $v-\frac{5}{2}s^5=k^5s^5/q^5$, $w-\frac{5}{2}s^5=l^5s^5/q^5$,

$x-\frac{5}{2}s^5=m^5s^5/q^5$, $y-\frac{5}{2}s^5=n^5s^5/q^5$, $z-\frac{5}{2}s^5=p^5s^5/q^5$,

Adding these six equations we get

$$s-15s^5=(s^5/q^5)(h^5+k^5+l^5+m^5+n^5+p^5).$$

Let $h^5+k^5+l^5+m^5+n^5+p^5=q^5$. $\therefore\ s=\frac{1}{2}$.

$\therefore\ u=\frac{1}{32}[\frac{5}{2}+(h^5/q^5)]$, $v=\frac{1}{32}[\frac{5}{2}+(k^5/q^5)]$, $w=\frac{1}{32}[\frac{5}{2}+(l^5/q^5)]$,

$x=\frac{1}{32}[\frac{5}{2}+(m^5/q^5)]$, $y=\frac{1}{32}[\frac{5}{2}+(n^5/q^5)]$, $z=\frac{1}{32}[\frac{5}{2}+(p^5/q^5)]$.

Let $h=4$, $k=5$, $l=6$, $m=7$, $n=9$, $p=11$, $q=12$.

$u=\frac{1217}{15552}$, $v=\frac{625205}{7962624}$, $w=\frac{81}{1024}$, $x=\frac{638887}{7962627}$, $y=\frac{2803}{32768}$, $z=\frac{783131}{7962624}$.

Let $h=5$, $k=10$, $l=11$, $m=16$, $n=19$, $p=29$, $q=30$.

$u=\frac{19441}{248832}$, $v=\frac{1217}{15552}$, $w=\frac{609110051}{7776000000}$, $x=\frac{38624111}{486000000}$, $y=\frac{632260099}{7776000000}$, $z=\frac{812611149}{7776000000}$.

AVERAGE AND PROBABILITY.

58. **Proposed by HENRY HEATON, M. Sc., Atlantic, Iowa.**

From a point on the surface of a circle two lines are drawn to the circumference. Required the average area that may be cut from the circle in this way if the lines are supposed to be drawn at equal angular intervals.

Query I. How does this differ from problem 32?

Query II. Is *sector* the proper word to use for the surface thus cut off?

Query III. Is it absolutely correct to use the word *random* in average problems?